

Report on Visit to Sungkyunkwan University in Korea by International Training Program

Department of Electrical Engineering and Computer Science Nagoya University Kazuki Keyamura

I participated in long-term dispatch of International Training Program (ITP) and researched at Sungkyunkwan University (SKKU) in Korea for 60 days from December 22nd, 2010 to February 19th, 2011, I will report it as follows.

About host institution

Sungkyunkwan University has campuses in Seoul city and Suwon city. Soul campus has department of humanity, art and gymnastic course. I visited Center for Advanced Plasma Surface Technology (CAPST) of the Suwon city where physical science departments gathered in.

In CAPST, the advanced research in various fields such as the development and evaluation of new functionality film materials made with plasma and plasma diagnostics are performed. This time, I am assigned to the laboratory of professor Han who is director of CAPST and researched. The laboratory of Professor Han is researching chiefly plasma enhanced chemical vapor deposition (PECVD) and magnetron sputtering and there are so many experimental devices and film evaluation devices in there so they have advanced technologies of depositing and thin film analysis.

About experiment

- Research theme in Korea

Currently, my research theme in Japan is thin Diamond Like Carbon (DLC) film deposition with PECVD. I told Professor Han want to learn about PECVD and film analysis before abroad by e-mail, he suggest me some research topics and there was a theme about depositing gas barrier coating on plastics by PECVD. I thought that this theme is most close to my current research topic and could learn many about film analysis so I decided on this theme.

- Background

Silicon Oxide thin film has many good properties as a



Fig. 1 CAPST is inside this building

transparency barrier film such as anti-scratch, chemical resistance and gas barrier property. Recent year it is used as one of the coating technique to mobile electronics and digital camera.

In these years Organic Light Emitting Diode: OLED is drawing attention as a new light device. Compared to liquid crystal display, it doesn't need a backlight so it can be thinner and using flexible substrate such as plastics, we can make a thin, flexible display. However there is a problem that OLED gets deteriorate by water vapor and oxygen so the lifetime is short.

- Research purpose

Deposit transparent barrier film on plastic and set the research purpose to make Water vapor Transmittance Rate: WVTR lower than 10^{-4} cc/m²/day. And also measure the film property.

- Experiment

I did my research with Dr. SuBong Jin. We used Capacitive Coupled Plasma (CCP) equipment to deposit

silicon oxide film. For a precursor we used OMCTS (D4). OMCTS is a liquid at room temperature so we introduced it from the upper electrode shower head by bubbling by oxygen gas. We can introduce RF power from not only the top electrode but the bottom electrode to bias the substrate. Also we evacuate from the bottom by only rotary pump. We used glass and PET as substrate.

What we did for film analysis is

First we measured the film by FT-IR and checked the chemical structure of the silicon oxide film. Next we measured substrate temperature and ion flux (ion current density) by thermocouple and oscilloscope connected to the copper substrate. Also we requested to the company to measure WVTR by the equipment called MOCON.

About my lifestyle

● **Lifestyle in the laboratory**

At first, we talk about my recent research with Dr. Jin and I got an advice about what we are going to research in Korea and what I should do for research at Japan. He was studying about film coating much longer than me so his advice was very exact and helpful.

At the first time, Dr. Jin has to organize for the society and can't do a research together so I studied about CVD by reading a book and an article about CVD. Also I don't have knowledge about silicone oxide film so I read an article that Mr. Jin wrote and related article about silicone oxide film to get knowledge about the research.

We did an experiment about silicon oxide together on the late half.

There were laboratory meeting at every Tuesday and the doctor in the laboratory reported about the study reports last week and this week's schedule. Also at my first time meeting, they did a simple introduction about their research theme for me. The presentation slides were made by English so I realized their high English skills.

All professor Han's laboratory students were more than two years older than me related to the military and it was very impressive to me that many students were 30's. In my laboratory in Japan, the age of the students was almost near me so it was a very good experiment to communicate with a student older than me. Also I felt that every student was studying very hard and concentrated even at the experiment

or deskwork. I went to the laboratory on Saturday for study sometime and even in Saturday, there were all doctors and almost all master students were in the laboratory so I thought students in Korea has very high motivation for study again.

We usually eat lunch at the cafeteria in the university and the price was very inexpensive that was almost 200-300 yen. Also the taste was very good, the lineup was mainly soup, rice and two accompanying dishes. For me it was a little strange that eating rice by dip into the soup and drinking water after we eat after the lunch.

We often eat dinner in the laboratory using food delivery service. In Korea delivery service is very advanced than Japan very much so we can see many bikes with food carrier around and inside the university. The price was almost 400-600 yen even if it is a delivery food so I can eat in very low price.

Sometimes we eat outside by doctor student's car and eat many types of Korean food. I heard about Korean food is very spicy before I went Korea but I didn't know that there was a spicy garnish like kimchee even with not spicy food and that was very impressive for me. I like spicy foods so daily meal was my fun, especially I like sundub-chige (spicy soup with bean curd).

After dinner we sometimes went to play billiards. In Korea billiard is the one of the most popular spot to play so there were many spots to play billiard in Korea. The rule was different than usual rule that there were no pockets at the table and the rule was very simple, however it was difficult than I thought and it was hard for me to win even if I had a handicap.

Lifestyle in the guesthouse

This time I used the university's guest house to stay for. The room was very large and there were all home electronic appliances and furniture such as television, bed, refrigerator, laundry machine and cleaner with the paper how to use written in English so I could use these equipment without inconvenience. Also I can access the internet so I was very comfortable during the stay.

What I was surprised especially was the floor heating system was introduced at the guesthouse and not only the floor but the room was very warm that it was warmer than my house. The temperature in Korea was most cold in

December to February and it was more than 10°C lower than Nagoya where I live and also the air was very dry is the difference to Japan whether so I thought that their protection to cold was very good.

In the guesthouse there was a little kitchen that I could cook. During February 2-4 was a holiday called Solulal (ancient New Year's Day) in Korea

During Solulal, shops, restraints and also the laboratory was closed like Japanese New Year's Day so I have to cook my meal and did it. I went to the supermarket called e-mart to buy the foodstuff with Mr.Jin by car. In Korea people buy stuff for several days at once so everything was very big and bought stuff by a big cart so it was very similar to American style. Also at there I bought my new hand cream and globes.

There were two convenience stores between the guest house and the laboratory so I mainly bought a drink and snacks there. The price was as low as the convenience store in Japan and the lineup was almost same but just has less bread and packed lunch



Fig.2 Guesthouse which I used

Living at rest day

I went around Seoul by train for sightseeing or shopping in my rest days. We can go to Seoul by train about one hour without changing the line and also the price was not as high as in Japan that almost about 300 yen at round trip so I could travel easily to Seoul. We don't use paper ticket at the train station in Korea but an IC card was used at everywhere so I thought they were doing completely. I went to East Gate, South Gate market, Myongdong(Seoul's downtown). In

Myongdong there were many shops around the streets and very ebullient like Sinjuku in Japan.

Else I went to N Seoul tower in Namsan Mountain and the world heritage Chongmyo Shrine and Changdeok Palace. At N Seoul tower I can see the view of the Seoul city and it was very beautiful. I didn't know but it was a famous date spot for Korean people and the member of the laboratory had gone with their girlfriend. Chongmyo Shrine and Changdeok Palace was an architecture that could feel the history of Korea very good and could know the living of the palace people. These were a very good experiment for me. Both had a Japanese guide and be a friend with a Japanese traveler which came to Korea.

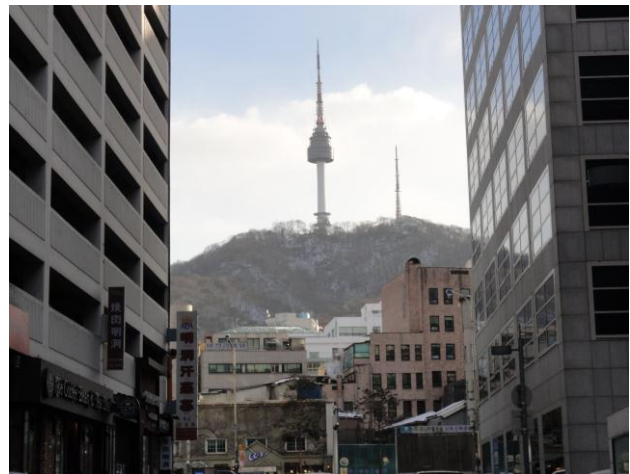


Fig.3 N Seoul tower looking from Myongdong

What I have learned

From this International Training Program which I lived 60 days in Korea, I have learned Korean people's living, culture and thinking, which I couldn't know at Japan through my own experience.

Recent years we can get foreign countries' information from the internet easily, this time I could get not only information but much experience that could not get from the internet. This precious experience could teach me the thinking of global point of view and be a big experience of my life.

This time I had never stayed abroad single for long time so I was first worried that I could live on. However the laboratory members, especially Mr.Jin help me very much and communicating by English I get used to Korea finally. From learning the importance of communicating in foreign

countries, if someone comes from foreign country I'd like to communicate much more.

For study, in another research environment I feel the Korea's high study level and the good point of my laboratory objectively. This will be a good experiment for me to continue study in Japan.

Finally I'd like to express my gratitude to professor Han, all CAPST members who welcomed me warmly and ITP staffs who gave me this opportunity.